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DENVER,CO

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13. ABSTRACT (*Maximum 200 words*)

IN ACCORDANCE WITH RECOMMENDATIONS PUT FORTH IN THE DEPT OF THE ARMY'S REPORT ON CARBON ADSORPTION TREATMENT OF CONTAMINATED GROUND WATER AT RMA. A FULL SCALE CALGON ADSORPTION UNIT WAS INSTALLED AT RMA AND BEGAN OPERATING IN JULY 1978. TO INSURE OPERATION IN COMPLIANCE OF THE CEASE AND DESIST ORDERS BY THE STATE OF COLORADO DEPT OF HEALTH, THE UNIT HAS BEEN RUNNING FROM JULY 1978 TO THE PRESENT. ONE OF THE PRIME OBJECTIVES OF THE PROGRAM OF INSTALLATION RESTORATION IS "TO ACQUIRE TECHNOLOGY TO DEVELOP AND IMPLEMENT CONTAINMENT AND TREATMENT SYSTEMS." TO ADDRESS THIS SPECIFIC NEED AT THE RMA SITE, CALGON CORP INSTITUTED IN ITS ADSORPTION SERVICE CONTRACT AN ANNUAL REVIEW OF ALL DATA COLLECTED WITH A SUBSEQUENT TECHNICAL REVIEW OF ALL THE RESULTS OBTAINED. IT IS THE PURPOSE OF THIS REPORT TO REVIEW THE OPERATION OF THE ADSORPTION SYSTEM AND THE RESULTS OBTAINED IN LIGHT OF PREVIOUS TREATABILITY STUDIES.

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REMOVAL OF TRACE ORGANICS FROM GROUNDWATER USING GRANULAR ACTIVATED CARBON

ROCKY MOUNTAIN ARSENAL

DENVER, COLORADO

ANNUAL TECHNICAL REVIEW
FY 1979

ACTIVATED CARBON DIVISION
CALGON CORPORATION

By

L.E. HOOD
TECHNICAL SERVICES COORDINATOR

REMOVAL OF TRACE ORGANICS FROM GROUNDWATER USING GRANULAR ACTIVATED CARBON

ROCKY MOUNTAIN ARSENAL

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ANNUAL TECHNICAL REVIEW
FY 1979

PREPARED BY:

ACTIVATED CARBON DIVISION
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ROCKY MOUNTAIN ARSENAL
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DEPARTMENT OF THE ARMY

ROCKY MOUNTAIN ARSENAL

~~DENVER, COLORADO 80240~~

Commerce City, Colorado 80022

SARRM-TOI-E

3 Jul 79

SUBJECT: Transmittal of Project Report

Commander
US Army Toxic & Hazardous
Materials Agency
ATTN: DRXTH-IS (Don Campbell)
Aberdeen Proving Ground, Maryland 21010

Inclosed is the FY 79 annual technical report submitted in accordance with ITARMS Task 1.05.3, which represents a technical evaluation of the performance of the Calgon Activated Carbon Process as operated in conjunction with the north boundary pilot containment system for the removal of trace organic contaminants from RMA groundwater.

FOR THE COMMANDER:

Irwin M. Glassman

IRWIN M. GLASSMAN
Director of Technical Operations

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as

TABLE OF CONTENTS

TABLE OF CONTENTS

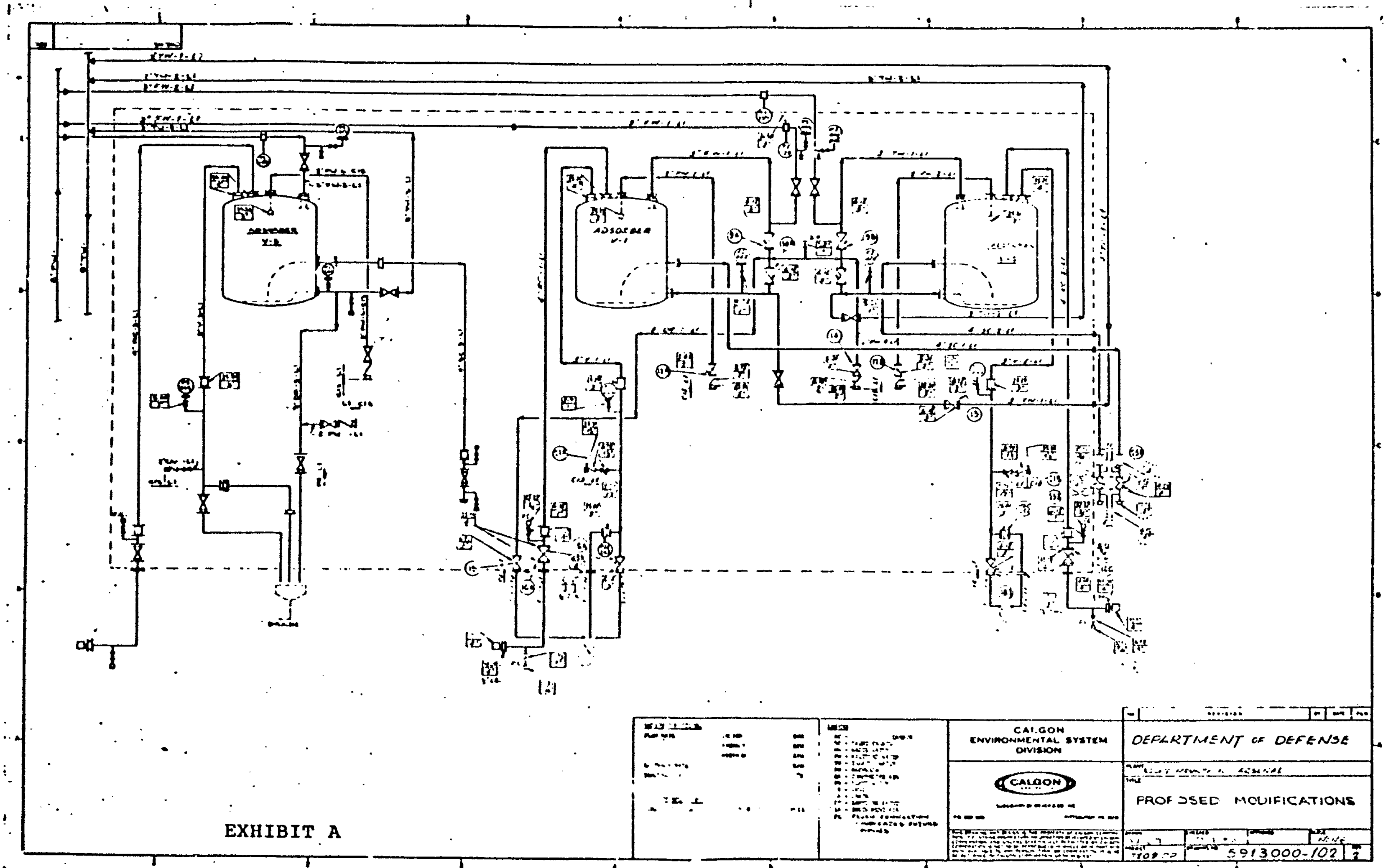

ADSORBER V-1
CALGON
ENVIRONMENTAL SYSTEM
DIVISION
CALGON
DEPARTMENT OF DEFENSE
PROPOSED MODIFICATIONS
5913000-102

EXHIBIT A

EXHIBIT B
ACTIVATED CARBON ADSORPTION SYSTEM
ROCKY MOUNTAIN ARSENAL
DENVER, COLORADO

ADSORPTION SYSTEM DESCRIPTION

This General Process Description pertains to the proposed Activated Carbon Water Treatment Facility located in Rocky Mountain Arsenal's plant.

The influent water will be pumped from the wells to the feed sumps located at the Adsorption System site. The wells, pumps, and conveyance system to the feed sumps will be provided by Rocky Mountain Arsenal.

The water in the feed sumps will be pumped at a controlled rate through the Adsorption System. A flow control system will operate controlling flow to the Adsorption System on the basis of the water level in the feed sumps. The sumps, feed pumps and flow control system will be provided by Rocky Mountain Arsenal. Equipment for the Adsorption System consists of three (3) lined carbon steel adsorbers to provide for adsorption of the dissolved organic contaminants.

The influent will be pumped at a controlled rate downflow through the Adsorption System. This will consist of three (3) single stage adsorbers. Each adsorber is rated for 75 psig at 150°F and is designed to contain 20,000

pounds of Activated Carbon on a dry basis.

The system is designed so that all three adsorbers will be available to treat influent at the same time. The treated effluent from each adsorber will be collected in a common header and conveyed to the battery limits for disposal by Rocky Mountain Arsenal.

This system design is predicated on the use of Calgon Corporation's Activated Carbon delivered in their specially designed trailers. The carbon delivery system is integral with the use of Calgon Corporation's equipment and carbon.

Introduction:

In accordance with recommendations put forth in the Department of Army's report on Carbon Adsorption Treatment of Contaminated Groundwater at Rocky Mountain Arsenal dated 15 October 1977 a full scale Calgon Adsorption unit was installed at Rocky Mountain Arsenal (RMA) and began operating in July 1978. To insure operation in compliance of Cease and Desist orders by the State of Colorado Department of Health issued on 7 April 1975, the unit has been running from July 78 to the present.

One of the prime objectives of the Program of Installation Restoration is "To acquire Technology to develop and implement containment and treatment systems." To address this specific need at the RMA site, Calgon Corporation instituted in its Adsorption Service Contract an annual review of all data collected with a subsequent technical review of the results obtained. It is the purpose of this report to review the operation of the Adsorption System and the results obtained in light of previous treatability studies performed by Calgon Corporation and RMA personnel.

As previous assessments were made at pseudo steady-state conditions over a relatively short period of time the evolution into the existing system and current operation was only possible through close cooperation between RMA and

Calgon personnel. The last years operation of a full scale system has allowed the acquirement of technology to achieve the goal of eliminating contaminant migration at the RMA site.

Finally, Calgon Corporation would like to extend its' appreciation to the Projects Development Evaluation Division Personnel, RMA for the cooperation exhibited during the past year.

Conclusions:

- Based on a maximum allowable DIMP concentration of 500 ppb in the effluent at breakthrough, the carbon usage rates for the two completed cycles from July 79 to June 79 are 1.90 # carbon/1000 gal wastewater (Cycle 1) and 1.29 # carbon/1000 gal wastewater (Cycle 2). This compares with a 1.1 # carbon/1000 gal wastewater obtained from the pilot studies conducted at Rocky Mountain Arsenal.

- Higher than expected carbon usage rates are a direct result of bed siphoning with subsequent air pocket formation.

- Maintenance downtime during FY 79 averaged less than 1% based on a 365 day operating year.

- Determination of the DIMP concentration to determine carbon bed exhaustion has been demonstrated as a sufficient criteria for monitoring purposes.

- Solids loading to the Adsorption System were much lower than expected due to the excellent performance of the dewatering wells. Resultant backwash frequency was one backwash every 2 - 4 weeks.

Recommendations:

- During the next carbon change-out (approximately September) install a siphon break on the effluent line prior to the recharge wells.

- TOC levels should be incorporated in conjunction with DIMP concentrations in determining bed life.

- Prior to initial design on potential system expansion RMA and Calgon personnel should decide on expected levels and frequency of TOC for future treatment considerations.

- Due to lower than expected suspended solids loading, the design hydraulic rate for future design considerations should be 10 GPM/Ft.^{2} versus the current design of 4 GPM/Ft.^{2}.

- During periods of extremely low influent solids the dual media filters should be backwashed once every two weeks to minimize bed compaction.

Discussion:

A. System Description[4]

1. Plant Facilities

The influent water is pumped from the dewatering wells to the feed sump located at the adsorption site. The wells, pumps and conveyance system to the feed sumps is provided by Rocky Mountain Arsenal.

The water conveyed to the feed sump is pumped at a controlled rate through the Adsorption System. A flow control system operates controlling flow to the Adsorption System on the basis of the water level in the feed sump. The sump, feed pumps and flow control system are provided by Calgon. Equipment for the Adsorption System consists of two (2) lined carbon steel pressure filters 4 ft. diameter, two (2) lined carbon steel adsorbers 10 ft. diameter by 11 ft. sidewalls and associated appurtenances to provide for filtration of the influent, adsorption of the dissolved organic contaminants and transfer of Activated Carbon into and out of the adsorber.

The influent is pumped at a controlled rate downflow through the two (2) filters in a parallel mode. Each filter contains four (4) feet of filter media consisting of a blend of graded coal and sand.

Each lined carbon steel filter vessel is rated for 100 psig at 150°F. The filters are operated in parallel until such time that backwashing is required. Backwashing may be effected manually or on a preset time interval. A high pressure drop alarm is provided to signal premature filter plugging indicating the need to manually initiate the backwash sequence. The backwash sequence is effected by isolating and backwashing one filter at a time with filtered water from the on-stream filter for a preset time period. When the backwashing operation is complete, the filter is automatically returned to service. Solids laden backwash water is conveyed to a backwash water settling sump. After an appropriate time period to allow for settling, the settling sump is decanted to the feed sump for reprocessing. Periodically RMA personnel remove settled sludge from the backwash settling sump.

The filtered water flows under pressure to the adsorption section of the Adsorption System. This consists of two (2) single stage adsorbers. Each adsorber is rated for 75 psig at 150°F and is designed to contain 20,000 lbs. of Activated Carbon.

The system is designed such that only one adsorber will be in service at a time. The filtered water passes downflow through the adsorber in service. The treated effluent from the adsorber is conveyed to the battery limits for disposal by RMA.

When the carbon in the adsorber becomes exhausted, the Spent Carbon is replaced with Activated Carbon. Fresh Activated Carbon is delivered to RMA in specially designed trailers. The Activated Carbon is transferred from the Calgon trailer to the adsorber by filling the trailer with treated water to slurry the Activated Carbon and pressurizing the trailer with compressed air. The treated water for the transfer is treated by the Adsorption System and stored in the empty adsorber prior to the arrival of the Calgon trailer. Once this operation is complete, the Adsorption System can be placed back in service. Calgon supplied an air compressor system to provide compressed air for the carbon transfer operations as well as any compressed air required for instrumentation or valve operators.

The Spent Carbon is transferred from the exhausted adsorber to the empty Calgon trailer as a water slurry by pressurizing the adsorber with compressed air. The slurry water is drained from the Calgon

trailer to the feed system for treatment in the Adsorption System. The Calgon trailer removes the Spent Carbon from RMA.

Shown in Table I are the design conditions and performance capabilities of the system installed at RMA.

2. Operation & Maintenance

A major factor on deciding to install the Calgon unit at the RMA facility was its ease of operation and minimal manpower requirement.[1] During FY 79 downtime amounted to less than 1% based on a 365 day operating year. The problems encountered were simplistic in nature and are typical in any system start-up. Specifically, flow recorders not operating properly, pump seals needing replacement and a faulty solenoid valve were the extent of problems encountered.

Included in the Appendix are typical GC/MS analyses of the influent and effluent of the Adsorption System. It is worthwhile to note the effluent scan. This particular sample was taken 6 days prior to carbon changeout and it is evident that one need only monitor the DIMP concentration for determining the breakthrough characteristics. This point was addressed in a previous study[1] and has been verified during the past years operation.

TABLE 1[5]

SYSTEM DESIGN AND PERFORMANCE CAPABILITIES

Parameter	System Design Performance Value	System Design Capabilities
Flow		
Average Daily	252,000 GPD	288,000 GPD
Instantaneous Peak	200 GPM	200 GPM
Pump Discharge Pressure		System Relief @75 psig
Temperature	$35^{o}F - 100^{o}F$	150^{o}Fht. Maximum
pH - Influent	7.0 - 8.0	6.0 - 9.0
Suspended Solids	20 mg/l	See Contract Note 2
Total Organic Carbon	Average Daily Concentration 9 mg/l	Instantaneous Maximum 25 mg/l
Diisopropyl Methyl Phosphonate	Average Daily Concentration 400 ug/l	Instantaneous Maximum 3,500 ug/l
Chlorides	Average Daily Concentration 500 mg/l	Average Daily Concentrat 1,000 mg/l
Organo-Sulfur Compounds as P-Chlorophenyl Methyl	Average Daily Concentration 200 mg/l	Instantaneous Maximum 1,000 mg/l
Dicyclopentadiene	Average Daily Concentration 500 mg/l	Instantaneous Maximum 3,000 mg/l
Oil & Grease	)	
Other Organic Chemicals and Solvents	) SEE CONTRACT NOTES	
Water Stability	)	

Discussion:

B. System Performance

1. Adsorption System

Summarized in Table 2 and Fig. 1, 2, 3 & 4, and as a basis for this discussion is a comprehensive data analysis of previous work both pilot scale and full scale. The carbon usage rates as presented represent three categories. The theoretical rate is based on isotherm work and assumes 100% removal from the beginning to the end of the cycle. The second and third columns presented are based on actual field data and represent two different breakthrough criteria as shown. In actual practice, a fresh bed is ordered when the effluent DIMP concentration reaches 50 ppb. Due to inherent lags in logistics, the "Spent" bed is actually transferred out several days later which allows the effluent DIMP concentration to approach the 500 ppb limit. The carbon capacities as presented are obtained in an analagous manner.

The prime concern of Calgon is the effect of bed siphoning. Due to the possibility of flow stoppage and downstream hydraulic characteristics of the recharge wells it is not only possible but highly likely that siphoning will occur. The ramifications of this are that siphoning allows

air to enter the bed and upon refilling with influent one is guaranteed of air pocket formation.

The consequence of this is channeling through the bed severely limiting the adsorption capacity. Input from RMA personnel indicate that hydraulic irregularities indeed existed and when placed in light of the potential of siphoning there is no question as to the probability of the occurrence. There is no means of measuring the effect except to state that past experience in other applications has shown usage rates deteriorating from 20 - 75% of expected values. The installation of the siphon break as recommended will prevent this event and it is the opinion of Calgon that usage rates will approach the pilot study numbers.

The second area of concern with regard to carbon consumption is the influent TOC levels. The data in Table 1 suggests a profound effect with regard to TOC. The original pilot work done with bog water had TOC levels averaging 39 mg/l. Placing this in perspective with the observed usage rate of .9# carbon/1000 gal treated versus a theoretical value of .33# carbon/1000 gal treated and keeping in mind the relatively low capacity of carbon for DIMP - 10.5 mg/gm theoretical or 0.1 wt. %

pickup - it is not hard for one to postulate that at increased levels of TOC, there is substantial competitive adsorption taken place with "other" compounds occupying adsorption sites that would normally be available for DIMP. It is difficult to access the impact of the TOC levels for future consideration but based on data available, it would not be out of line to expect carbon usage rates to be in the neighborhood of 1.5 - 2.5 times the expected values with TCC levels of 25 mg/l and higher. The effect becomes more pronounced as DIMP concentrations become lower due to a lowe. driving force making it that much harder to compete for available sites.

High TOC levels shown in Figure 2 represent initial analytical problems and are not actual influent conditions. During the operating year influent TOC levels averaged out almost identical to original validation studies [1,2,3]. However, for future consideratior at RMA, the impact of TOC should be addressed and placed in proper perspective.

2. Dual Media Filtration

During the original well water studies[3], intermittant suspended solids problems were encountered. As a result of this, Calgon's proposal included dual media filtration prior to adsorption. The reason for

this is that due to the large flows being processed through the Adsorption System even low level suspended solids (20-50 ppm) would cause excessive pressure drops and shortened operating cycles. The potential for changing carbon on solids build-up versus organic loading existed and as such filtration was included. During the past year, suspended solids have been extremely low (<20 ppm) as a result of excellent performance by the dewatering wells. Backwash frequency has consistently been averaging once per month.

Based on the past year's performance, it is Calgon's recommendation to increase the design hydraulic capacity to 10 GPM/Ft.^{2} versus the original capacity of 4 GPM/Ft.^{2}. This rate is applicable providing the solids remain below 20 ppm. Additionally, it is recommended that the filters be backwashed once every 2 weeks to prevent bed compaction and alleviate any potential plugging problems due to precipitation of inorganic salts. From an economic standpoint it is also recommended that filtration be utilized in any future work. Filtration prior to adsorption insures carbon bed changeout on organics only. It is economically more attractive to install filters versus taking a risk if upsets develop in the dewatering wells necessitating a carbon bed change due to a surge in the suspended solids level.

TABLE 2

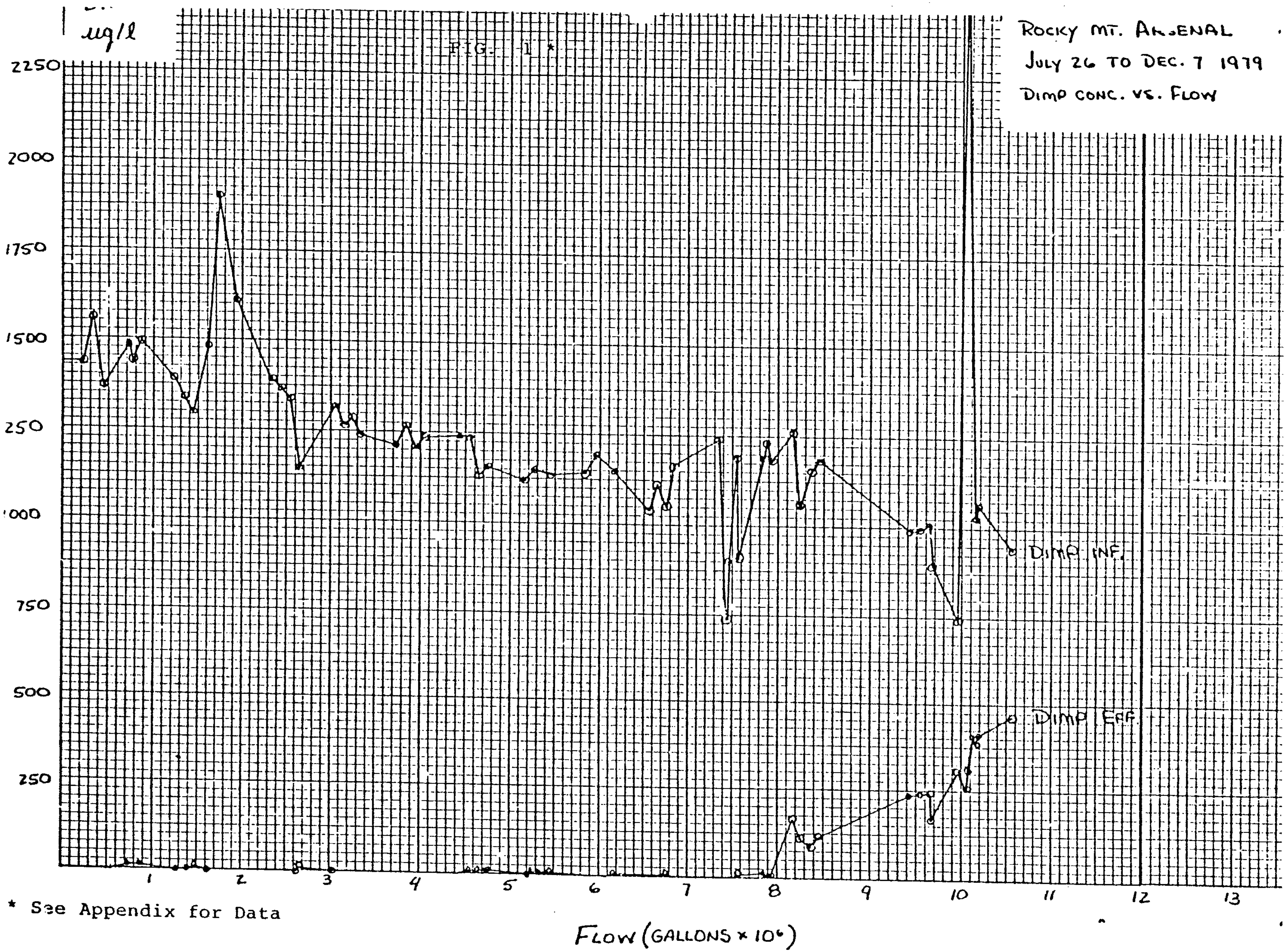
COMPARATIVE CARBON USAGE RATES & CAPACITIES

ROCKY MOUNTAIN ARSENAL

SOURCE	Influent DIMP mg/l (Average)	Influent TOC mg/l (Average)	Contact Time Min.	Carbon Usage Rates lbs. Carbon/1000 gal Treated Theoretical*	Carbon Usage Rates 50 ppb	Carbon Usage Rates 500 ppb	Carbon Capacity mg DIMP/gm carbon Theoretical*	Carbon Capacity Actual
I. Original Pilot Study 1,2,3								
1) Bog Water	417	39	15	0.33	0.90	-	10.46	3.78
2) Well Water								
a) Col. 1	2440	9.5	15	1.09	1.31	0.95	18.74	7.79
b) Col. 2	-	-	30	1.09	1.33	1.05	-	12.95
c) Col. 3	-	-	45	1.09	1.20	1.10	-	-
d) Col. 4	-	-	60	1.09	1.18	1.10	-	-
II. Full Scale System								
1) Run 1 July-Dec.	1205	12.0	60	0.68	2.52	1.90	14.85	5.19
2) Run 2 Dec.-May	1024	6.6	60	0.61	1.54	1.29	14.07	5.68

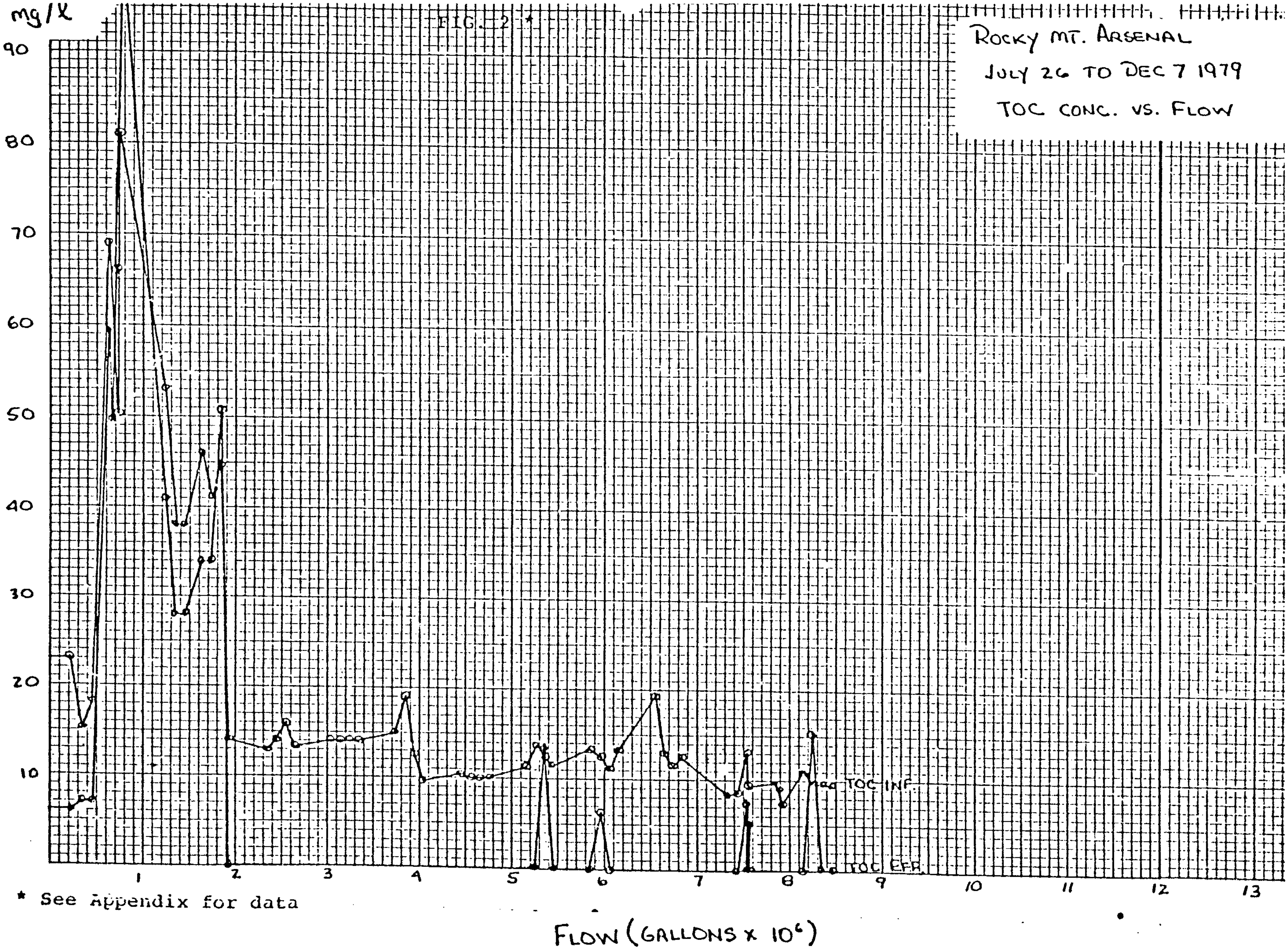
* See Appendix

FIG. 1 *



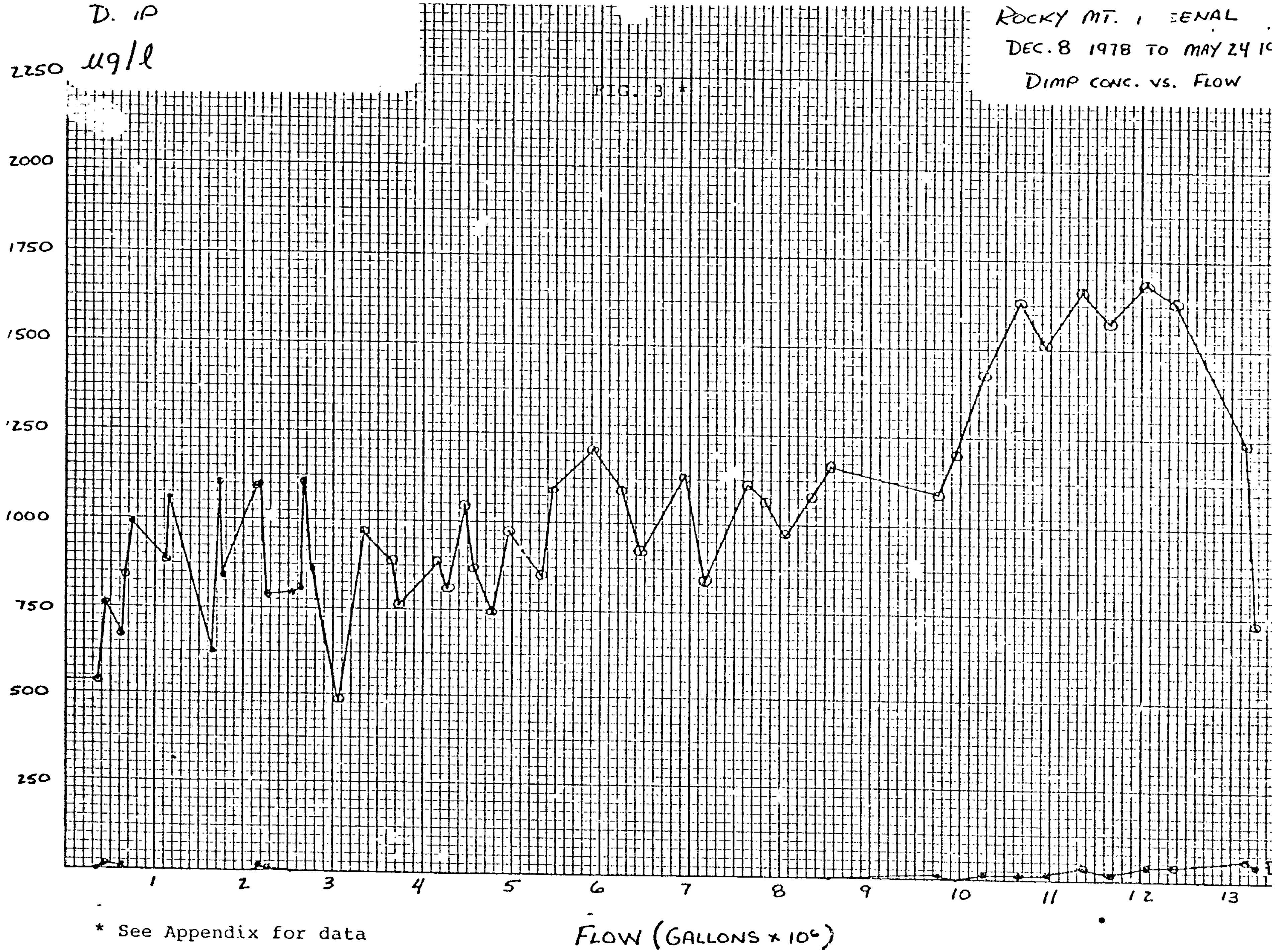
* See Appendix for Data

FIG. 2 *



* See Appendix for data

FIG. 3 *



* See Appendix for data

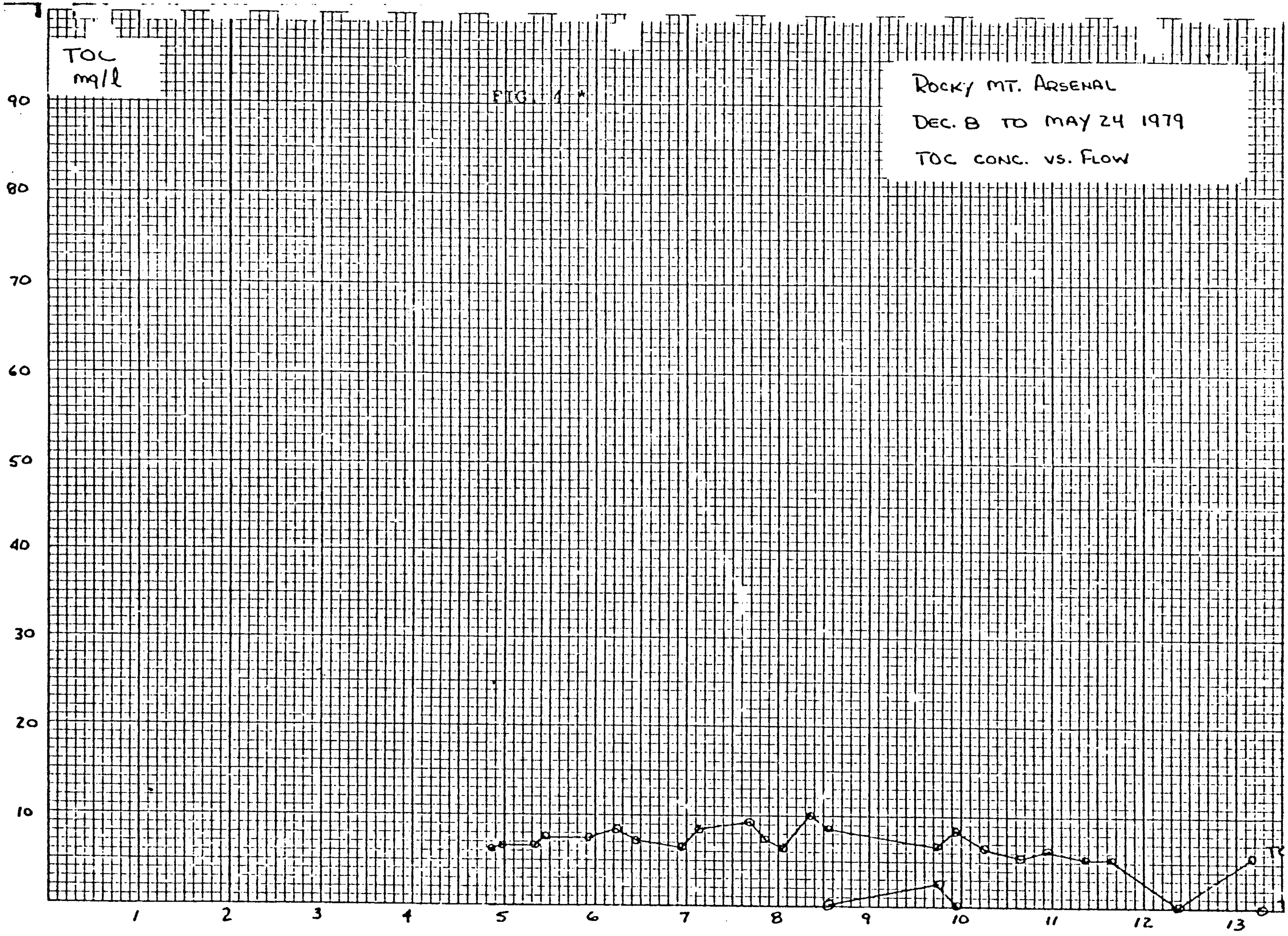


FIG. 1 *

* See Appendix for data

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1. "U.S. Army Report on Carbon Adsorption Treatment of Contaiminated Ground Water at Rocky Mountain Arsenal", 10/15/77.

2. "Removal of Trace Organics from Groundwater Using Granular Activated Carbon - Preliminary Report", Calgon Corporation, 1/25/77.

3. "Removal of Trace Organic from Groundwater Using Granular Activated Carbon - Addendum to Final Report" R. E. Whitesell, Calgon Corporation, 8/19/77.

4. Contract No. DAAA05-78-C-0005. Exhibit A Calgon Corporation/ Department of Army.

5. Contract No. DAAA05-78-C-0005. Exhibit B Calgon Corporation/ Department of Army.

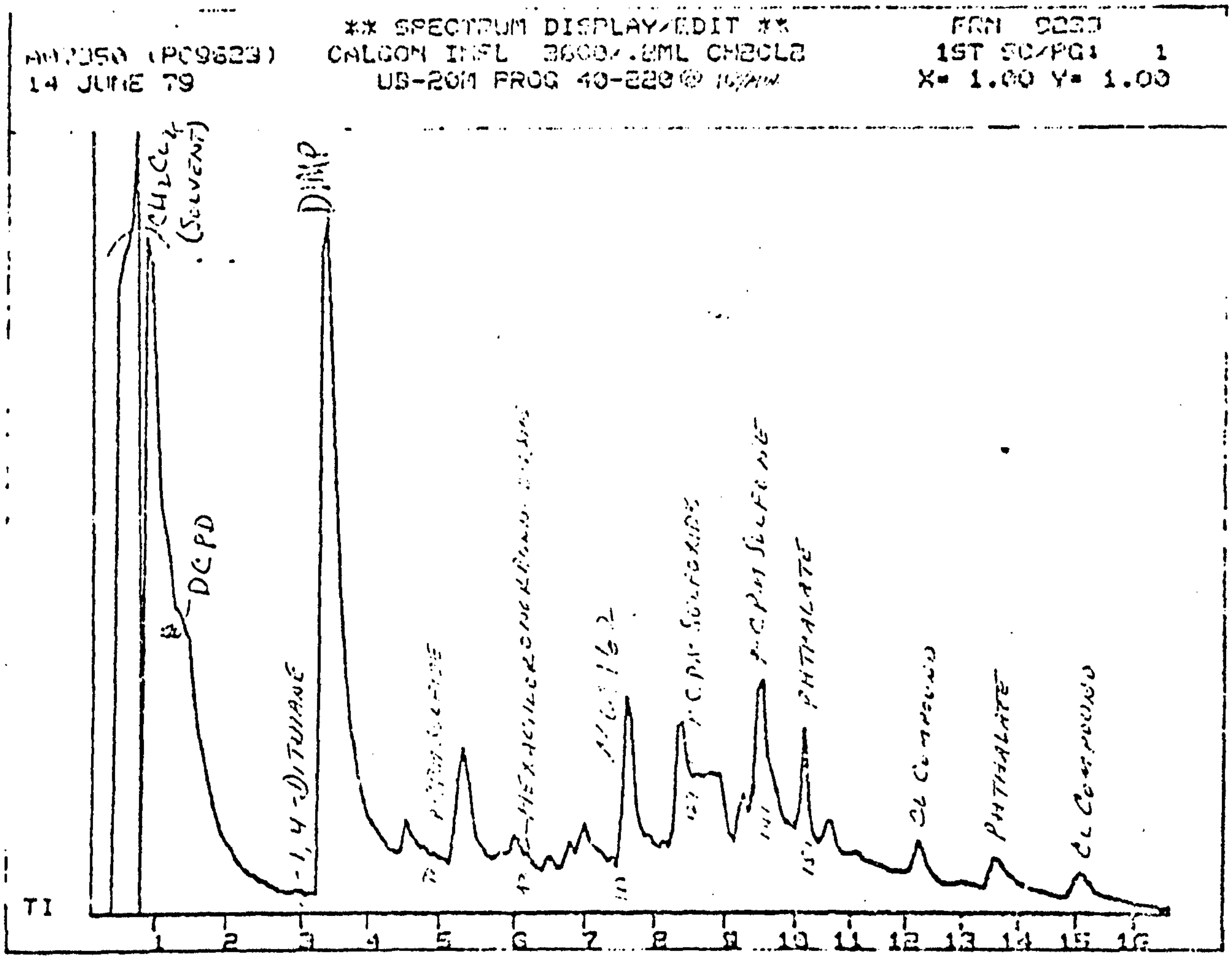
A P P E N D I X

I. GC/MS Scan Influent & Effluent

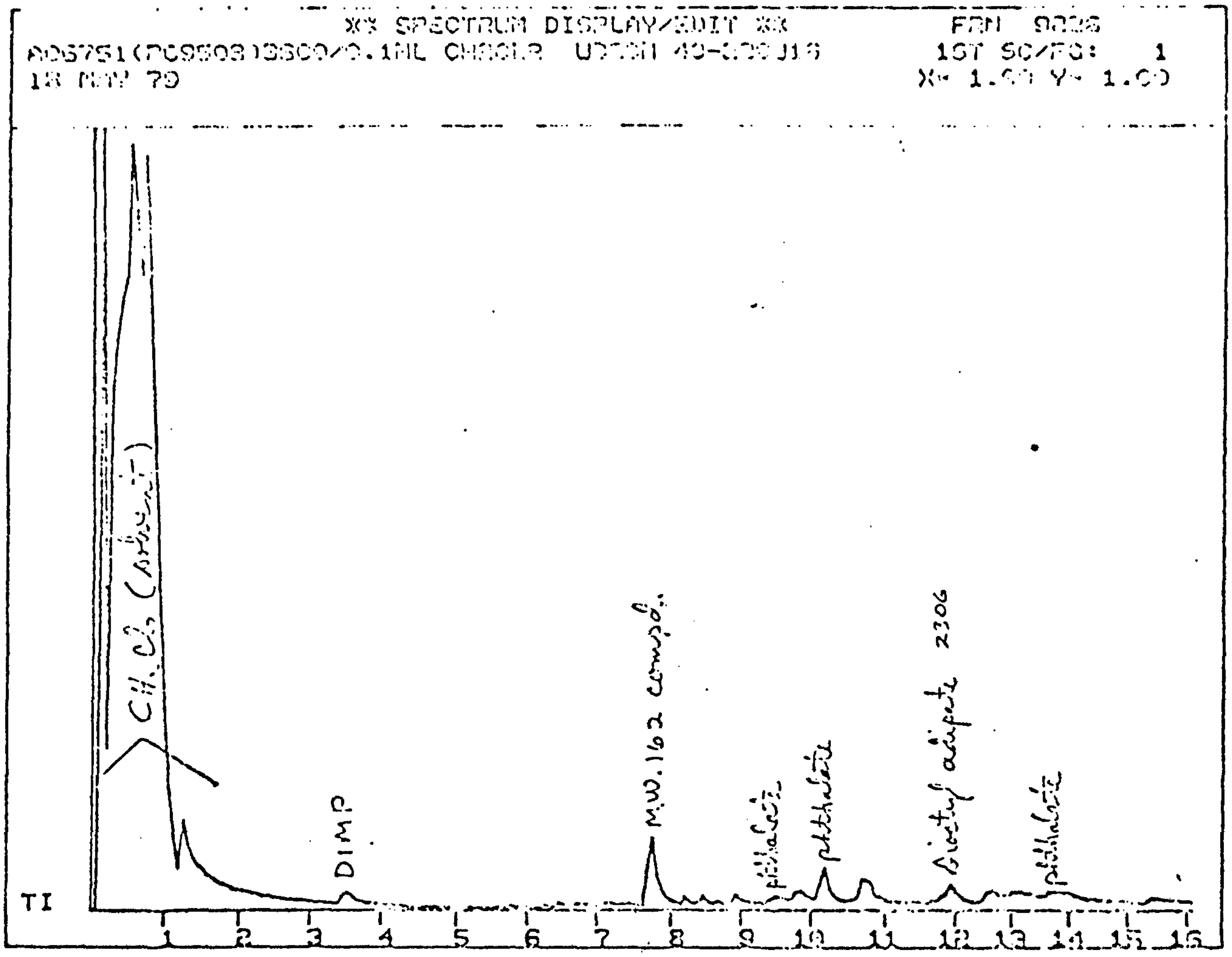
II. DIMP Isotherm

III. FY 79 Operating Data

GC/MS SCAN-INFLUENT



GC/MS SCAN - EFFLUENT



Isotherm Discussion:

All theoretical values presented in the preceeding report are based on the accompanying isotherm. Theorectical capacities were obtained from the following relationship:

$$\log y = 0.33 \log x + 0.155$$

Where: x = Influent DIMP concentration ppb

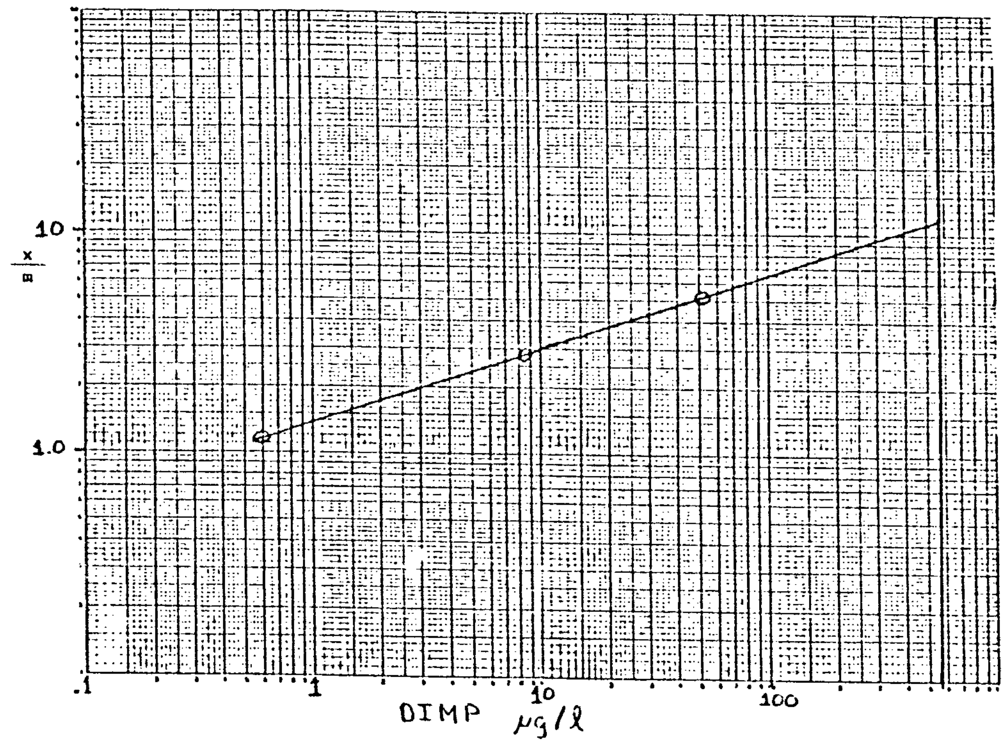
y = carbon capacity $(\frac{x}{m})$ μg DIMP/mg carbon

One should note that concentrations above 570 ppb of DIMP will give extrapolated results. As such it should be considered to what extent one is beyond the data, and accordingly place the results in proper perspective.

CALGON
SUBSIDIARY OF MERCK & CO., INC

Date	August 6, 1976			pH	8.3
Name of Plant	Rocky Mountain Arsenal	Type Carbon	React	TOC	7 mg/l
Location	Denver, Colorado	Sample Volume	500 ml	SS	< 5 mg/l
Specific Contaminant	DIMP	Pretreatment	Filtration	Color	
Temperature	Ambient	Agitation Time	1 hr.		

Grams Carbon (m)	(c) Remaining ppb	μg	Mg Adsorbed (x)	$\frac{x}{m}$
Control	570	285		
50	51	25.5	259.5	5.19
100	8.5	4.25	280.75	2.81
250	.6	.3	284.7	1.14



By ______________________

FISCAL YEAR 1979 - OPERATING DATA

	Cumm. Flow	DIMP IN As Reported	DIMP IN Assumed	DIMP OUT As Reported	DIMP OUT Assumed	TOC IN	TOC OUT
Jul. 26	223570	1436	1436	.5	0	23.00	6.0
Jul. 27	387338	1557	1557	.5	0	15.00	•7.0
Jul. 28	469142	1374	1374	.5	0	18.00	7.0
Aug. 1		No Value Rpt.		1.10	1.10	69.00	59.8
Aug. 2		No Value Rpt.		.5	0		90.9
Aug. 3	708704	1405	1405	1.10	1.10	50.00	68.0
Aug. 4	797907	1433	1433	2.31	2.31	81.0	134.0
Aug. 5	887110	1498	1498	2.40	2.40		
Aug. 9	1243922	1398	1398	.5	0	53.0	41.0
Aug. 10	1302728	1337	1337	.5	0	39.0	28.0
Aug. 11	1472982	1298	1298	.67	.67	38.0	28.0
Aug. 15	1618642	1470	1470	.5	0	46.0	34.0
Aug. 16	1734922	1900	1900	.5	0	41.0	34.0
Aug. 17	1834366	No Value Rpt.		.5	0	45.0	31.0
Aug. 18	1940844	1906	1906	.5	0	14.0	.5
Aug. 22	2353902	1399	1399	.5	0	13.0	.5
Aug. 23	2460214	1305	1305	.5	0	14.0	.5
Aug. 24	2556118	1341	1341	.5	0	16.0	.5
Aug. 25	2689798	1139	1139	.58	.58	12.0	.5
Aug. 29	3076438	1324	1324	.5	0	14.0	.5
Aug. 30	3147980	1272	1272	.5	0	14.0	.5
Aug. 31	3226188	1290	1290	.5	0	14.0	.5
Sept. 1	3542369	1241	1241	.5	0	14.0	.5
Sept. 5	3741466	1216	1216	.5	0	15.0	.5
Sept. 6	3838894	1272	1272	.5	0	18.0	.5
Sept. 7	3942338	1205	1205	.5	0	12.5	.5
Sept. 8	4041938	1226	1226	.5	0	9.8	.5
Sept.12	4442050	1230	1230	No Value Reported		10.6	.5
Sept.13	4547844	1228	1228	1.32	1.32	10.0	.5
Sept.14	4651778	1127	1127	1.38	1.38	10.0	.5
Sept.15	4788180	1157	1157	1.39	1.39	10.0	.5
Sept.19	5161952	1121	1121	.5	0	11.1	
Sept.20	5268766	1144	1144	.66	.66	13.9	.5
Sept.21	5370442	1140	1140	.66	.66	13.2	12.8
Sept.22	5473940	1130	1130	.76	.76	11.2	.5
Sept.26	5878090	1140	1140	.5	0	13.4	.5
Sept.27	5984080	1180	1180	.60	.60	13.7	6.10
Sept.28	6080982	No Value Rpt.		.5	0	11.0	.5
Sept.2[illegible]	6175506	1150	1150	.57	0	13.2	.5

FISCAL YEAR 1979 - OPERATING DATA

	Cumm. Flow	DIMr As Reported	IN Assumed	DIMP As Reported	OUT Assumed	TOC IN	TOC OUT
Oct. 3	6569136	1047	1047	No Value Reported		19.4	.5
Oct. 4	6664340	1105	1105	.60	.60	14.00	.5
Oct. 5	6759722	1050	1050	.60	.60	11.40	.5
Oct. 6	6859702	1170	1170	.5	0	12.70	.5
Oct. 11	7879780	1240	1240	.5	0	8.18	.5
Oct. 12	7450884	748	748	.5	0	8.5	.5
Oct. 15	7466448	900	900	.5	0	8.0	.5
Oct. 17	7528046	1190	1190	2.0	0.0	12.0	7.35
Oct. 18	7539556	1068	1068	0.98	0.98	9.04	.5
Oct. 19	7549840	915	915	5.57	5.57	10.1	5.32
Oct. 20	7641920	1062	1062	7.17	7.17	9.0	1.5
Oct. 24	7861750	1191	1191	11.2	11.2	9.3	.5
Oct. 26	7892704	1220	1220	7.16	7.16	9.1	.5
Oct. 27	7918384	1177	1177	7.88	7.88	7.1	.5
Oct. 31	8148204	1264	1264	164.0	164.0	11.0	.5
Nov. 1	8287870	105	1055	108.0	108.0	0.7	15.5
Nov. 2	8379674	1157	1157	98.0	98.0	9.7	.5
Nov. 3	8479368	1181	1181	116.0	116.0	9.4	.5
Nov. 14	9438912	984	984	231.0	231.0		
Nov. 15	9526842	990	990	239.0	239.0		
Nov. 16	9620308	1006	1006	248.0	248.0		
Nov. 17	9642184	895	895	172.0	172.0		
Nov. 21	9981084	736	736	301.0	301.0		
Nov. 22	10052332	2670	2670	268.0	268.0		
Nov. 24	10071008	1039	1039	313.0	313.0		
Nov. 28	10106192	1026	1026	408.0	408.0		
Nov. 29	10116128	1061	1061	382.0	382.0		
Nov. 30	10124870			370.0	370.0		
Dec. 1	10136958	878	878	409.0	409.C		
Dec. 7	10566056	949	949	462.0	462.0		
Dec. 12	10847893	587	587	2.0	0.0		
Dec. 13	10978989	764	764	13.0	13.0		
Dec. 19	1117033	674	674	4.0	4.0		
Dec. 21	11229717	844	844	2.0	0.0		
Dec. 22	11296927	985	985	2.0	0.0		
Dec. 27	11672097	885	885	2.0	0.0		
Dec. 28	11744933	1063	1063	2.0	0.0		

FISCAL YEAR 1979 OPERATING DATA

	Cumm. Flow	DIMP As Reported	IN Assumed	DIMP As Reported	OUT Assumed	TOC IN	TOC OUT
Jan. 3 '79	12282907	630	630	2.0	0.0		
Jan. 4	12289651	1200	1200	1.0	0.0		
Jan. 5	12396395	795	795	2.0	0.0		
Jan. 10	12640115	1085	1085	2.0	0.0		
Jan. 11	12759776	1094	1094	8.30	8.30		
Jan. 12	12829437	787	787	4.64	4.64		
Jan. 16	13108083	793	793	2.0	0.0		
Jan. 17	13177744	806	806	2.0	0.0		
Jan. 18	13257011	1110	1110	2.0	0.0		
Jan. 19	13336778	862	862	2.0	0.0		
Jan. 24	13733614	484	484	2.0	0.0		
Jan. 26	13869630	970	970	2.0	0.0		
Jan. 31	14213185	906	906	2.0	0.0		
Feb. 2	14348613	768	768	2.0	0.0		
Feb. 7	14759825	880	880	2.0	0.0		
Feb. 9	14842565	814	814	2.0	0.0		
Feb. 14	15049415	1048	1048	2.0	0.0		
Feb. 16	15458049	873	873	2.0	0.0		
Feb. 21	15479635	743	743	2.0	0.0		
Feb. 23	15562492	975	975	2.0	0.0	6.1	Negligible
Feb. 28	15894635	855	855	2.0	0.0	6.6	Negligible
Mar. 2	16025051	1095	1095	2.0	0.0	6.7	"
Mar. 9	16481505	1205	1205	2.0	0.0	7.3	"
Mar. 14	16807545	1090	1090	2.0	0.0	8.1	"
Mar. 16	17009195	915	915	2.0	0.0	7.1	"
Mar. 21	17513645	1126	1126	2.0	0.0	6.3	"
Mar. 23	17714745	833	833	2.0	0.0	8.7	"
Mar. 28	18218745	1113	1113	2.0	0.0	9.1	"
Mar. 30	18420345	1065	1065	2.0	0.0	7.3	"
Apr. 2	18752745	961	961	2.0	0.0	6.1	"
Apr. 4	18924345	1078	1078	2.0	0.0	10.0	"
Apr. 6	19425940	1170	1170	2.0	0.0	8.5	"
Apr. 10	20375545	1086	1086	4.3	4.3	6.8	"
Apr. 20	20537145	1206	1206	2.0	0.0	6.6	"
Apr. 23	20839845	1425	1425	4.2	4.2	5.5	"
Apr. 27	21242745	1630	1630	7.3	7.3	6.1	"
Apr. 30	21845145	1504	1504	17.2	17.2		

FISCAL YEAR 1979 - OPERATING DATA

	Cumm. Flow	DIMP As Reported	IN Assumed	DIMP As Reported	OUT Assumed	TOC IN	TOC OUT
May 4	21948345	1067	1067	27.1	27.1	5.2	Negligible
May 7	22280746	1575	1575	15.0	15.0	5.2	"
May 11	22653945	1680	1680	29.7	29.7	Negligible	"
May 14	22956245	1635	1635	33.2	33.2	5.4	"
May 23	25762745	1236	1236	51.1	51.1	Negligible	"
May 24	27868545	729	729	49.6	49.6		